Order Code RL31571

Military Aviation Safety

Updated November 25, 2003

/name redacted/
Specialist in National Defense
Foreign Affairs, Defense, and Trade Division

Military Aviation Safety

Summary

Military aviation safety is a concern to policy makers in both the Department of Defense (DoD) and Congress. DoD is concerned about improving safety because aviation accidents erode DoD's war fighting capabilities in many tangible and intangible ways.

DoD aviation accidents are classified by the severity of injury or property damage. Class A accidents are the most severe events and the rate at which these accidents occur is the most frequently used yardstick for measuring aviation safety.

The Office of the Secretary of Defense, and the military Services (including the Coast Guard) have different roles and responsibilities in military aviation safety promotion and mishap investigations. Generally speaking, the Services have the most active and involved role in promoting aviation safety. The Services conduct two types of mishap investigations, generally referred to as safety investigations and legal investigations. In the commercial and civil sector, the National Transportation Safety Board (NTSB) conducts a single investigation.

The status of military aviation safety depends heavily on one's viewpoint. There is no consensus on how well the Services are doing in promoting and improving aviation safety. Some believe that the current mishap rate is acceptable. Others believe that it is unacceptable and can be improved. Others believe that DoD should strive for, and achieve, a "zero mishap rate."

Over the past 50 years, data show that the total annual number of accidents and the rate at which they occur have significantly decreased. However, this improvement appears to have stagnated over the past 10 years. Comparisons of safety between the military and the civilian world, between the U.S. military and foreign militaries, between the different military Services, and between different aircraft types may offer some perspective on the state of aviation safety in the U.S. military.

While it is easy to see the negative effects of aviation accidents, determining and mitigating accident causes are often more difficult. Many factors can contribute to a single accident. Frequently, "conventional wisdom" does not apply when identifying the leading causes of aviation mishaps. Aircraft age and increased operations tempo (OPTEMPO) are frequently claimed to cause accidents. However, the relationship between these factors and mishaps is unclear. It does appear clear, however, that human error is a leading cause of mishaps.

Those who wish to promote safety and to improve upon today's military aviation safety record may consider a variety of approaches. Focusing senior leaders in DoD on the problem may help. "Fencing off" money in DoD's budget specifically for safety is another cited approach. Tying aircraft procurement funding to a desired or acceptable Class A mishap rate may be considered, as may more aggressive fielding of numerous flight safety technologies.

Contents

List of Figures

List of Tables

Military Aviation Safety

Introduction

Military aviation safety is a concern to policy makers in both the Department of Defense (DoD) and Congress. DoD is concerned about improving safety because aviation accidents erode DoD's war fighting capabilities in many tangible and intangible ways. Accidents degrade operational readiness. They reduce the number of aircraft readily available, both because of damage and aircraft destruction, and also because aircraft are often grounded while accidents are investigated. Accidents consume financial resources. Damaged aircraft must be repaired, and destroyed aircraft replaced. Accident investigators must be trained, and investigations funded. Accidents are hard on personnel. They hurt morale, and cost lives. According to DoD records, 3,072 people died in military aviation accidents between 1980 and 2003.[1]

While it is easy to understand the negative effects of aviation accidents, determining and mitigating accident causes are often more difficult. Many factors can contribute to accidents. Aircraft age, pilot training, weather or other environmental conditions, human error, mechanical failure, and new aircraft designs are just some of the factors that may contribute to aviation accidents. Often, more than one factor can contribute to an accident.

Congress has consistently expressed concern for military aviation safety. For instance, at the request of House Armed Services Committee (HASC), the General Accounting Office (GAO) conducted a review of military aircraft accidents. (GAO/NSIAD-96-69BR, *Military Aircraft Safety: Significant Improvements Since 1975*.) The HASC directed GAO to update this study in 1998 (GAO/NSIAD-98-95BR, *Military Aircraft Safety: Serious Accidents Remain at Historically Low Levels.*).

Congress has also tasked DoD to conduct high level studies on military aviation safety and recommend specific actions on ways to reduce accidents. P.L. 104-201 (Sec. 2255) for example, expressed Congress's belief that DoD should develop and manage a joint service effort to address flight safety, and called for the Secretary of Defense to study the feasibility of such a program. Congress also directed DoD to develop "new approaches to reduce the incidence of recurring safety problems, such as human error." P.L. 105-85, (Sec. 1046) directed DoD to conduct a similar study, this time on the advisability of revamping DoD's accident investigation processes to more closely parallel those of the National Transportation Safety Board.

---

[1] Data provided by Service Safety Centers (See Appendix 1): 613 fatalities for the Army, 1,193 fatalities for the Air Force, and 1,266 fatalities for the Navy and Marine Corps.

Top DoD leadership has recently taken steps that suggest it shares congressional concern over military aviation safety. In a May 19, 2003 memorandum, Secretary of Defense Donald Rumsfeld challenged DoD's top leaders to "reduce the number of mishaps and accident rates by at least 50% in the next two years." Secretary Rumsfeld noted that DoD accident rates were on the rise and were negatively affecting operational readiness. Under Secretary of Defense David Chu is leading this department-wide effort, which has been labeled the Defense Safety Oversight Council (DSOC).

Accident Investigation Processes and Procedures

Terms and Definitions. An accident (in aviation circles, frequently and synonymously called a mishap) is an unplanned event or series of events that result in damage to DoD property, and result in occupational illness to DoD military or civilian personnel, injury to DoD military personnel both on-or off-duty, injury to on-duty DoD civilians, damage to public or private property or injury/illness caused by DoD operations. Battle damage is not an accident. Intentional vandalism or destruction of property is not an accident. Neither purposeful assault on personnel nor suicide are considered accidents.

DoD divides aircraft accidents into three categories; flight accidents, flight-related accidents, and ground operations accidents.[2] An **Aircraft Flight Accident** is an accident in which there is intent for flight, and damage to the aircraft occurs. Explosives, chemical agents, or missile events that cause damage to an aircraft with intent for flight are categorized as flight accidents. An **Aircraft Flight-Related Accident** is an accident in which there is intent for flight and no reportable damage to the aircraft itself, but the accident involves fatality, reportable injury, or reportable property damage. An **Aircraft Ground Operations Accident** (Non-Flight Rate Producing) is an accident in which there is not intent for flight and which results in damage to an aircraft, death or injury. This applies to aircraft both on land and onboard ships. Damage to an aircraft when it is being handled as a commodity or cargo, is not reportable as an aircraft accident.

The Department of Defense keeps track of aviation flight mishaps by flying hour. Aircraft flight accident rates, for example, are expressed in terms of how many occur for every 100,000 flying hours. As a point of illustration, in FY2001, the Army experienced 24 Class A flight mishaps while flying 2,067,104 hours. This equates to a mishap rate of 1.16.

DoD aviation accidents are classified by the severity of injury or property damage. Property damage severity is calculated as the sum of the costs associated with DoD and non-DoD property damaged in the accident. If injury results, a mishap is reported even if the costs are less than the minimum dollar criteria.

---

[2] In addition to aircraft accidents, DoD also tracks explosives and chemical agents, motor vehicles, ground and industrial, off-duty military, unmanned aerial vehicles, guided missiles, maritime, nuclear, and space accidents.

Class A accidents are the most severe events. A mishap is categorized as Class A if, the total cost of damages to Government and other property is $1 million or more, a DoD aircraft is destroyed, or an injury and/or occupational illness results in a fatality or permanent total disability. **Class B** accidents are those in which the resulting total damage cost is between $200,000 and $999,999. An injury and/or occupational illness results in permanent partial disability, or when three or more personnel are hospitalized for in patient care as a result of a single accident. **Class C** accidents are those in which the resulting total damage cost is between $20,000 and $199,000, a nonfatal injury causes any loss of time from work beyond the day or shift on which it occurred, or a nonfatal occupational illness or disability causes loss of time from work or disability at any time.

The Services have adopted these accident categories, classification criteria, reporting formats, and procedures mandated by the Office of the Secretary of Defense. This does not, however, prevent the Services from collecting, classifying, and maintaining additional data for their individual accident prevention needs. The Army, for example, also tracks accidents that they categorize as D, E, and F in terms of severity.

DoD Safety Roles and Responsibilities. The Office of the Secretary of Defense, and the military Services (including the Coast Guard) have roles and responsibilities in military aviation safety promotion and mishap investigations. The Deputy Undersecretary of Defense for Installations and Environment (DUSD IE) is the lead OSD office for accident reporting and safety promotion. This office sets policy guidance on safety promotion and mishap investigations and provides oversight. It collects and analyzes accident data provided by the military Services, updates "measures of merit" for assessing safety promotion, and mishaps, distributes analysis and communicates the status of accident prevention efforts.

OSD and the Joint Staff do not generally have the expertise to participate in or conduct safety investigations, so the Services have lead responsibility for establishing procedures and implementing safety promotion initiatives and mishap investigations.[3] Specifically, the Services collect, maintain, analyze, and report accident property and injury data. If the mishap cause is identified, the Services are responsible for ensuring that effective corrective action is taken.

Each of the Services operates a Safety Center that is intended to be the locus of safety promotion and mishap investigation efforts.[4] General Officers independently review every safety investigation report of a serious aviation accident. This occurs both through the chain of command and through the independent efforts of the Service Safety Centers. The General Officers that command the Safety Centers also serve as the Service Safety Chiefs, answerable directly to the Service Chiefs of Staff.

DoD policy provides the Services with guidance, but also discretion and flexibility, in the execution of their responsibilities. For example, DoD Instruction

---

[3] Mishap Investigation, Reporting, and Record Keeping. Curtis Bowling, Assistant Deputy Under Secretary of Defense (Safety & Occupational Health). February 28, 2002.

[4] See Appendix I for Safety Center contact information.

6055.7. "Accident Investigation, Reporting and Record Keeping" directs the Services to establish procedures to use a disinterested third party to investigate Class A accidents whenever possible and produce investigation reports. Yet, OSD does not prescribe what "disinterested third party" means. Therefore, the Navy, for example, determines whether mishap investigators come from the fleet, or from the Navy Safety Center. If investigators come from the fleet, the Navy determines whether disinterested third parties can be found in the same squadron experiencing the mishap, or whether impartiality can be only found elsewhere in the air wing, or outside the air wing. The same is true for the Air Force and the Army.

OSD also gives the Services the freedom of issuing policies and guidance for when investigation boards are to be used for safety and legal investigations. The Services develop qualification criteria for accident investigators based on the complexity or severity of the accidents involved, and establish procedures to screen every fatality and determine whether or not it was accidental. The Services do not coordinate these policies and procedures among themselves, but tailor them to best satisfy their unique environments, cultures, and needs.

Investigation Types and Procedures. The Services conduct two types of mishap investigations generally referred to as safety investigations, and legal investigations. This contrasts to the process for investigating commercial and civil aviation accidents. In the commercial and civil sector, the National Transportation Safety Board (NTSB) leads a single investigation.

The purpose of **safety investigations** is to prevent future accidents. The Services are required by OSD to conduct a safety investigation for all Class A mishaps, and some Class B mishaps. Safety investigators collect and analyze information to determine the causes of the accident and make recommendations for corrective action. An important characteristic of safety investigations is that personnel interviewed by investigators can be granted confidentiality and immunity from punitive action. Information provided under this grant of immunity is called "privileged information."

The rationale behind conducting safety investigations and for allowing personnel to give privileged information is that, unlike commercial or civil contexts, national security demands that, to the extent possible, aircraft fleets not be grounded for indefinite periods of time. Granting immunity from prosecution and punitive action encourages personnel to provide frank and accurate information about aircraft mishaps and their causes. DoD officials believe that this, in turn, leads to the expeditious completion of mishap investigations and a quick determination of whether fleet-wide actions need to be taken. In addition to privileged information, safety investigations may also contain information that can be released to legal investigators or the general public.

There are many similarities in how Services conduct safety investigations. All four Services include medical experts, maintenance experts, and pilots or operations experts. All four Services also include representatives from their respective safety center. These representatives may be civilians with special safety expertise. There are also differences in how the Services conduct safety investigations. For example, Army safety investigations are led by representatives from the Army Safety Center.

The Air Force and Navy investigations are led by officers from outside their safety centers. Also, the senior officer of an Air Force Investigation Board must hold the rank of Colonel (O-6), and be a rated aviator. The senior member of the Navy's Aircraft Mishap board, can be a Commander (O-5).

The purpose of **legal investigations** is to inquire into all the facts and circumstances surrounding accidents as well as to obtain and preserve all available evidence for use in litigation, claims, disciplinary action, or adverse administrative actions. Legal investigations are required for Class A mishaps and all suspected cases of "friendly fire." Although non-privileged safety information acquired by a safety investigator may be made available to the legal investigation, the legal investigation is otherwise conducted independently from the safety investigation, and under procedures prescribed by the Service's Judge Advocates General (JAGs). Personnel assigned to conduct safety investigations will not conduct legal investigations of the same accident. Personnel currently assigned to full-time safety positions will not be appointed as a member of a legal investigation board. Legal investigation boards can be composed of both military and civilian personnel.

OSD also sets guidelines for how legal investigations are staffed. To ensure an objective and effective investigation, OSD instructs the Services to ensure that a majority of investigators are selected from units outside the mishap unit, or a unit not subordinate to the mishap unit. Also, at least one member of the board must be a member of the Armed Forces or an officer or employee of the Department of Defense with specialized knowledge and expertise pertaining to aircraft accident investigations. These guidelines can be waived, however, if the Services deem they are not practicable (either due to a remote accident location, a lack of available people, or a need to expeditiously begin the investigation).

Observations: Mishap Data and Causes

Assessing accident data over time can be useful when trying to make observations on whether safety is improving, worsening, or holding steady. Making observations on aviation safety trends depends on perspective. Making observations is complicated by wide variations in accident rates over time, and by the fact that the military Services do not record accident data in a coordinated and uniform manner.

From one perspective, it can appear that military aviation accidents are becoming less frequent, suggesting that military aviation is becoming safer. Over the last 50 years, for example, the frequency of DoD aviation accidents has dropped markedly. (See Appendix II). In 1955, for example, DoD suffered over 2,200 Class A aviation mishaps. By 1999, this number had dropped to 70. Perhaps more significantly, the annual number of mishaps per 100,000 flight hours has similarly dropped over this time period.[5] In 1975, the Class A Mishap Rate was over 4 per

---

[5] In 1954, DoD operated many more aircraft than it does today. Therefore, comparing 2,200 mishaps in 1955 to 70 in 1999 is not an "apples-to-apples" comparison. Dividing the number of mishaps by 100,000 flight hours makes the comparison of two different sized forces valid.

(continued...)

100,000 flight hours. In 1993 that rate had been cut in half.[6] In 1954, the Navy lost 776 aircraft to mishaps. By 2001, the number had dropped to 15 aircraft.[7] During this time period, DoD has implemented a variety of measures that it says have contributed to lowering mishap rates. The Navy, for example, began fielding aircraft carriers with angled decks. All the Services initiated safety programs, and opened safety centers during this time period.

From another perspective, however, it appears that while accidents may be less frequent than in the past, recent improvements in aviation safety may have slowed, and the frequency of accidents has not appreciably declined lately. The Defense Science Board noted that "the previously declining DoD accident rate (1950 to 1994) has now reached a plateau."[8] A review of DoD mishaps indicates that between 1995 and 2001, aviation mishap rates have remained relatively constant, at or near 1.5 per 100,000 flight hours.

In any given time span, the number of accidents can vary considerably, suggesting that improvements in safety may not be inevitable nor permanent. The time period 1997 to 2003 is a good example of the apparent variability in aviation accidents. On September 17, 1997, Secretary of Defense William Perry directed that all four military Services conduct a mandatory 24 hour cessation of aviation training missions. Concerned about a large number of aircraft mishaps, Perry urged commanders to "thoroughly examine our training missions, ensuring that our crews are appropriately tasked and that missions are conducted as safely as possible."[9] Just three years later, in FY2000, DoD reported that it experienced its safest aviation year up to that time, with only 1.23 accidents per 100,000 flight hours.[10] By February 2002, however, safety (in the Air Force) had again become cause for concern. Because "The Air Force has had twice as many aircraft crashes this year as it had at the same time in 2000 and 2001," Air Force Chief of Staff General John Jumper took the unusual step of ordering every unit worldwide to stop operations for a day to focus on safety.[11] The commander of the Air Force's Air Combat Command repeated

---

[5] (...continued)
The dotted lines on the charts in Appendix II indicate this "mishap rate" over time.

[6] See Appendix II.

[7] Captain Kurt Garbow. Deputy Special Assistant for Safety Matters. OPNAV N09FB. "Naval Aviation Safety Briefing." February 28, 2002.

[8] Report of the Defense Science Board Task Force on Aviation Safety. February 1997. Office of the Undersecretary of Defense for Acquisition and Technology. Washington, D.C. February 27, 1997.

[9] Memorandum for Secretary of the Army, Secretary of the Navy, Secretary of the Air Force. September 17, 1997. The Secretary of Defense. Washington, D.C.

[10] "Citing Mishap Rates, DoD Calls FY-00 the Safest Aviation Year Ever." *Inside the Air Force.* October 6, 2000.

[11] John Diedrich. "Air Force Ordered to Think Safety." *Colorado Springs Gazette.* February 8, 2002.

the "day off" tactic in December 6, 2002 because mishaps continued to accumulate.[12] Combined DoD Class A mishap rates for 2002 was 1.95, the highest rate in ten years (2.07 in 1992). FY2003 continued this negative trend, with a combined Class A mishap rate of 2.03. (See Appendix I)

Mishap Data

Assessing mishap data may provide some tentative observations regarding military aviation safety. While the Services keep large amounts of data and statistics, they do not record data in a uniform manner. This lack of uniformity, coupled with the wide variability in accidents over time, makes comparisons between the Services and different platforms difficult. In the civil sector, the National Transportation Safety Board (NTSB) also keeps accident statistics, but definitions and classifications are different from DoD definitions and classifications. Conclusions should be made cautiously.

Civilian versus Military Mishap Rates. National Transportation Safety Board (NTSB) statistics are available for U.S. commercial air carriers from 1982 to 2001. A review of these statistics indicates that major accidents[13] occurred during this time period .033 times per 100,000 flight hours.[14] As Table 1 shows, Class A mishaps in the military during a similar time period (1980-2000) occurred 81 times more frequently per 100,000 flight hours than major accidents occurred per 100,000 commercial flight hours.[15] Major accidents in general civil aviation are more prevalent than commercial accidents, and appear closer to DoD's experience. For example, from 1996 to 2001, civil training aircraft reportedly suffered 4.2 major accidents per 100,000 flight hours, and 4-seat, fixed landing gear aircraft suffered 3.9 major accidents per 100,000 flight hours.[16]

Table 1. DoD Aviation Class A Mishaps 1980-2000[17]

	Total #	Mishap Rate	Fatalities	Fatalities /Mishap
Army	605	1.98	552	.91
Air Force	1,002	1.64	1,152	1.14
Marine Corps	376	4.55	494	1.31
Navy	822	2.55	665	.8
DoD	2,805	2.68	2,863	1.04

---

[12] "Ari Force Pilots Will Take a Day Off." *Los Angeles Times*. December 6, 2002.

[13] A civil "major accident" is most analogous to a military Class A mishap. An accident is considered "major" by the NTSB when an aircraft is destroyed, or there were multiple fatalities, or there was one fatality and an aircraft was substantially damaged.

[14] [http://www.ntsb.gov/aviation/Table2.htm]

[15] The DoD average mishap rate from 1980-2000 is 2.68/100,000 flight hours. 2.68/.033 = 81.2.

[16] Ken Ibold. "Is Flying Safe?" *Aviation Safety*. March 2002. p.2.

[17] Source: Safety Centers. See Appendix II.

U.S. Military versus Foreign Military Mishap Rates. It would likely be useful to compare safety and mishap rates between the U.S. experience and that of foreign air forces. Unfortunately such comparisons are difficult to make. Foreign governments do not always make safety and mishap information publicly available. When they do, it often is not reported in ways that foster comparison. For example, often, a total number of mishaps is provided, but not flight hours. Or, mishaps are reported, but severity classifications are not included, or not comparable to U.S. mishap classifications (i.e. Class A, Class B). The most valid safety comparisons that can be made with U.S. air forces are likely with the air forces of other industrialized countries (e.g. NATO countries, Israel, Australia, Canada). These countries tend to fly the same aircraft as the United States, and they have the resources to train personnel and maintain equipment at comparable levels. It is generally believed that U.S. mishap rates are superior to those found in less industrialized countries, and at least comparable to those of industrialized countries.[18]

U.S. Coast Guard versus U.S. Military Mishap Rates. Comparing DoD's safety record to Coast Guard's may in many ways be more helpful than comparisons to the civil and commercial world. The Coast Guard flies many of the same aircraft as DoD (e.g. C-130 fixed wing aircraft and H-60 helicopters) and under conditions that may be closer to military conditions than commercial aircraft experience. Also, because the Coast Guard trains with and is closely associated with the military, the Coast Guard may share some of the Services' aviation culture and operating procedures. As the figure below indicates, the Coast Guard safety record compares favorably with DoD's from 1987 to 2001. The Coast Guard's Class A mishap rate averages 1.15/100,000 hours, and for 11 of 15 years its annual Class A mishap rate was lower or as low as the best Service mishap rate.

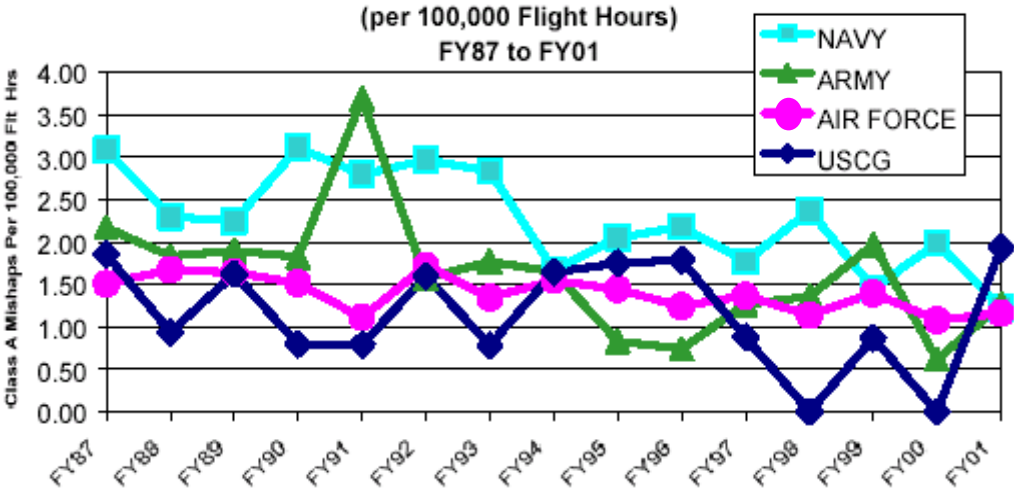
Service Comparisons. Between 1980 and 2000[19], the Air Force experienced the greatest number of Class A mishaps. Due to its very large number of flying hours (between 2 and 3.5 million hours annually) these mishaps translated into the lowest Class A mishap rate among the Services, with 1.6 per 100,000 flying hours. The Marine Corps experienced the fewest number of mishaps, but because it flies comparatively less, (between 260,000 and 460,000 hours annually) it showed the highest Class A mishap rate, with 4.55 per 100,000 flight hours, almost three times the Air Force rate. Also of interest is the total number of fatalities suffered in aviation accidents during this time period. The Air Force had the greatest number of fatalities during this time period, but the Marine Corps had the greatest number of fatalities per mishap, with at rate of 1.31 fatalities per event. The Navy experienced the lowest fatality rate with .8 per mishap.

---

[18] Author's survey of Air Force and Navy pilots and safety center personnel. April 2002 to August 2002.

[19] The years 1980-2000 were used because data are available for all Services and many different aircraft, the time span reduces the effects of a single bad event or year, the time span allows for aircraft maturation; it is a contemporary time period, and should reflect recent attempts to improve safety.

Figure 1. Aviation Class A Mishap Rates



Fixed Wing versus Rotary Wing Comparisons. Intuitively, it may make sense to many observers for rotary wing aircraft (helicopters) to have higher mishap rates than fixed wing aircraft. Helicopters are arguably more difficult to fly than fixed wing aircraft, and they tend to operate in more complicated, if not more hostile environments (e.g., low altitude obstacles such as trees and power lines). However, accident statistics do not always support intuition. On the one hand, it appears that Air Force helicopters have higher accident rates than Air Force fixed wing aircraft. Air Force statistics indicate that between 1980 and 2001 Air Force helicopters suffered a Class A mishap rate of 3.11, while fixed wing aircraft Class A mishaps were approximately half that, at 1.60.

On the other hand, Marine Corps helicopters have experienced lower Class A mishap rates than Marine Corps fixed wing aircraft. Between 1991 and 2001 (data unavailable from 1980-1990), Marine Corps helicopters experienced a Class A mishap rate of 2.84 while Marine Corps fixed wing aircraft experienced a much higher rate of 4.38. Two Marine Corps fixed wing aircraft (EA-6B *Prowler* and AV-8B *Harrier*) had higher mishap rates than the helicopter with the highest mishap rate (the AH-1W *Super Cobra*). Also, the KC-130's total lack of mishaps during this time period significantly reduced the fixed wing aircraft average. The average mishap rate for the remaining three fixed wing aircraft is double that (5.84) of the Marine Corps helicopters over this time period.

Table 2. Comparison of USMC Class A Mishap Rates 1991-2001

Helicopter	Mishap Rate	Fixed Wing Aircraft	Mishap Rate
AH-1W	4.04	EA-6B	4.44
UH-1N	3.71	AV-8B	10.22
CH-46E	1.86	F/A-18	2.87
CH-53	1.76	KC-130	0.0
Average	**2.84**		**4.38**

A review of Air Force Class A mishap statistics over the same time period (1991-2001) indicates that Air Force helicopters experienced a mishap rate of 2.93, very close to the Marine Corps helicopter rate. However, the Air Force fixed wing Class A mishap rate was 1.28; much lower than the corresponding Marine Corps rate of 4.38. In this period, fixed wing aircraft experienced both lower and higher Class A mishap rates than helicopters. This suggests that whether an aircraft is fixed or rotary wing may not, alone, be the strongest determinant of aviation safety. Other factors, such as the specific type of aircraft, or by which Service the aircraft is flown, may have a stronger influence on safety. Other scenarios, however, may contradict this suggestion.

Combat Aircraft versus "Non-Combat" Aircraft. Similar to the question of helicopter vs fixed wing aircraft accident rates, many may believe that combat aircraft (e.g. fighters and bombers) suffer from higher accident rates than non-combat aircraft (e.g. airlift, refueling and surveillance). However, an assessment of accident data suggests that the rate of Class A mishaps for combat aircraft may not be appreciably higher than for non-combat aircraft. Using the Air Force as a case study, and again examining the 1980-2000 time period, the Class A mishap rates of combat aircraft (1.68) is only marginally higher than non combat aircraft (1.66). Because some aircraft are relatively new and didn't generate data for the entire period 1980-2000, several (e.g. F-117, B-1, B-2, C-17, E-8) were not included. The Class A mishap rate of these aircraft can be included by narrowing the time frame considered (1991-2000). Again, the Class A mishap rates of combat aircraft (2.2) is slightly higher than non-combat aircraft (1.9).

Table 3. Comparison of USAF Class A Mishap Rates By Aircraft Type

1980-2000		1991-2000	
Fighters	**2.55**		**3.1**
F-15	2.26		1.9
F-16	3.31		3.5
A-10	2.08		1.77
		F-117	5.5
Bombers	**.82**		**1.31**
B-52	.82		.83
		B-1	3.1
		B-2	0.0
Lift/Refueling	**.44**		**.43**
KC-10[20]	.64		.96
KC-135	.36		.16
C-141	.23		.22
C-5	.56		0.0
C-130	.42		.3
		C-17	.98
Surveillance (and C^4)	**2.88**		**3.38**
E-3	.18		.39
E-4	2.7		0.0
U-2	5.78		6.2
		E-8	6.96
Combat Aircraft	**1.68**		**2.2**
Non-Combat Aircraft	**1.66**		**1.9**

Perhaps surprisingly, surveillance aircraft experienced slightly higher Class A mishap rates than fighters. Fighters experienced higher Class A mishap rates than bombers. By a wide margin, airlift and aerial refueling aircraft experienced the lowest Class A mishap rates in both time periods.

[20] First deployed 1981.

Accident Causes

Assessing the cause of mishaps is central to preventing them, or reducing their likelihood in the future. Many factors can contribute to aviation mishaps. Human error, mechanical failure, weather, and maintenance problems are some of the factors that can by themselves, or in conjunction, cause an aviation mishap. Often, singling out "the" cause of a given accident is difficult. Observers tend to argue that high operations tempo (OPTEMPO), aircraft age, and human error have strongest correlations with increased mishaps.

OPTEMPO. Many observers warn that simultaneous operational conflicts, and reduced manpower and equipment may speed up OPTEMPO to a degree that safety is compromised. Some fear that due to the demands of the war on terrorism less experienced people may be "back-filling" critical jobs, the military may be taking more chances, and an intensified training pace may result in increased aviation mishaps. For example, "Anytime you have an increase in the training cycle or in support of combat operations, it raises the probability that more accidents will occur," according to one observer.[21] Others argue that deploying overseas and fighting wars are what the military is designed to do, and that high OPTEMPO is "business as usual." Thus, mishap rates shouldn't, and don't, increase during war, they argue.

According to a 1996 GAO study, "while service studies have addressed the relationship of operating tempo to aviation mishaps, direct correlation has been inconclusive."[22] The GAO points out that "the relatively low incidence of Class A flight mishaps make drawing inferences and statistical correlations of variables with mishap rates difficult."[23] In this report, the GAO described two seemingly contradictory Air Force studies, one that found that there was not a cause and effect relationship between OPTEMPO and aviation mishaps, and another that found that high OPTEMPO posed an "obvious operational safety risk."

Office of the Secretary of Defense (OSD) records also suggest a tenuous relationship between OPTEMPO and aviation mishaps. As the chart below shows, aviation mishap rates have fluctuated during operational conflicts. Often, mishap rates have risen during conflicts, but they have decreased as well. Sometimes, as during Operation Joint Endeavor, mishap rates have been both relatively high and low.

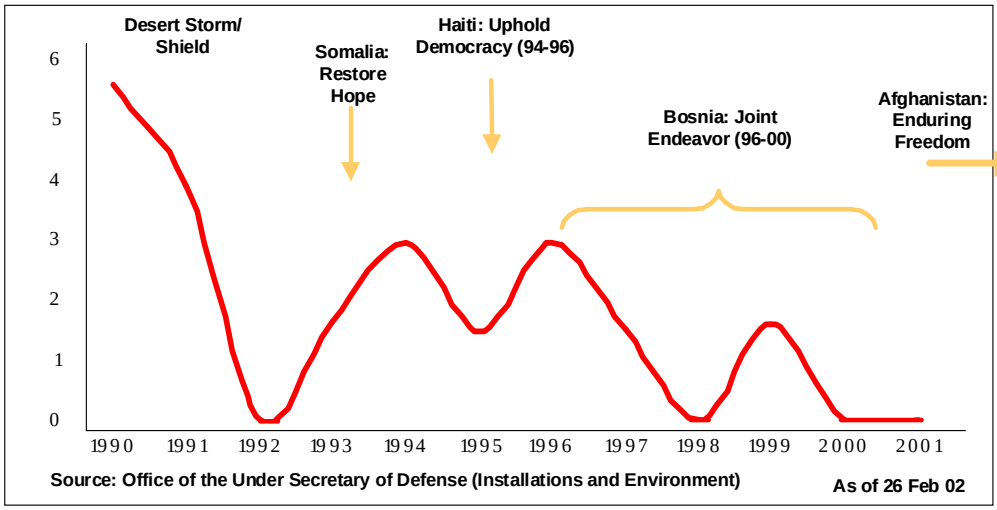
---

[21] Jane McHugh. "Shinseki" Cut Accidents." *Army Times.* September 2, 2002. p.8.

[22] "Mlitary Aircraft Safety: Significant Improvements Since 1975." General Accounting Office. GAO/NSIAD-96-69BR. February 1996. P.27.

[23] *Ibid*

Figure 2. Class A Accident Rates and Recent Conflicts



Some observers say that an apparent rise in aviation mishaps during FY2002 and FY2003 is in part attributable to pressure caused by the global war on terrorism.[24] "I think the system is straining under its previous burden. What we have is a previously strained and overburdened military system, and then we get ourselves into a war in Afghanistan" commented one safety expert.[25]

A spokesman for the Air Force Safety Center's aviation division reportedly claimed that higher accident rates wessre caused by the hazardous missions flown in Afghanistan and Iraq.[26] Yet, the chief of Air Force safety commented, "None of the accidents we have investigated so far this year for which there is a completed investigation have come up and said that training or ops tempo or things like that are contributing factors."[27] Marine Corps safety experts also downplay the relationship operations and mishaps: "In deployments, we are doing a fantastic job. It's back here at home in training, where we are not so focused that we are having problems (with mishaps)"[28]

While no correlation between high OPTEMPO and increased mishaps has been proved, it also hasn't been disproved. A great degree of uncertainty remains. Little is known, for example, of the OPTEMPO effects on maintenance, ammunition, training in country, living conditions, or personnel tempo.

Aircraft Age. Many observers argue that as aircraft age, they require more maintenance. More maintenance, in turn, presents increased opportunities for error

---

[24] See Appendix II for graphical depiction of increased mishap rates from FY2001-FY2003.

[25] Russell Carollo. "31 Dead In Military Aviation Accidents Since Oct. 1." *Dayton Daily News*. March 3, 2002.

[26] Bruce Rolfsen. "Friendlier Skies." *Air Force Times*. October 27, 2003. p.10.

[27] Bruce Rolfsen. "22 Flight Deaths, and a Search for Answers." *Air Force Times*. August 26, 2002. p.10.

[28] Sandra Erwin. "Navy Aviation Mishaps Cost $4.3 Billion Over Five Years." *National Defense*. October 2002. p.40.

and oversight. Also, it is argued, older parts and equipment are more likely to fail than newer equipment, causing aviation mishaps.

There is little debate that average age of DoD aircraft is increasing. In the Air Force, for instance, some estimate that the average aircraft age in 2002 was 22 years, up from 13 years in 1990.[29] The Congressional Budget Office (CBO) offered a more conservative estimate, "...the average age of Air Force aircraft...will exceed 15 years by 2002." But CBO cautioned that the average aircraft age will continue to increase into the next decade. "That average age will climb to a peak of almost 20 years in 2011 before starting to decline as Joint Strike Fighters become operational."[30]

Intuitively, this line of reasoning — that older aircraft are more prone to accidents — makes sense, and if true, one would expect aviation mishaps to increase as the age of the military's aircraft increased. However, mishap statistics and observations by military safety center officials bring into question a cause and effect relationship between aircraft age and mishaps. While the average age of Air Force aircraft, for example, has increased from 1990 to 2003, mishap statistics indicate that Air Force accidents have slowly decreased over this same time period (see Appendix II, chart 2). Further, Air Force officials are cited saying that there is no indication of increased material failures leading to accidents.[31]

It also appears that growing concern over Navy and Marine Corps accidents comes during a downward trend in material failures. Over the last 10 years the number of material failures contributing to a mishap has been .86 per 100,000 flight hours. Over the past five years, that rate has decreased to .71 per 100,000 flight hours.[32] Navy statistics indicate that between 1997 and 2001, material factors contributed to mishaps at a rate of .68 per 100,000 flying hours (See Table 4 below).

The Class A mishap rates for FY2002 and FY2003 are higher than FY2001. Some believe that this increase in mishaps is due to aging aircraft. Many of the aircraft involved in Class A mishaps, however, are among the younger aircraft of their type. A Marine Corps CH-53E helicopter crash that killed two Service members in Afghanistan was eight years old. An EA-6B *Prowler* that crashed into the Atlantic Ocean was 11 years old, and a Class A mishap in March 2002 involved a relatively young (13 years old) F-14 *Tomcat*.[33]

---

[29] Loren Thompson. "Aging Aircraft: Clinton Decay Continues Under Bush." Issue Brief. March 1, 2002. Lexington Institute.

[30] Statement of Christopher Jehn, Assistant Director National Security Division, Congressional Budget Office on Modernizing Tactical Aircraft. Before the Subcommittee on Airland of the Committee on Armed Services United States Senate. March 10, 1999.

[31] Tom Bowman. "Age of U.S. Aircraft Fleets Stirs Concern in Military." *Baltimore Sun.* April 15, 2002.

[32] *Ibid*

[33] Tom Bowman. "Age of U.S. Aircraft Fleets Stirs Concern in Military."*Baltimore Sun.* April 15, 2002.

Human Factors. In many ways, humans are more complicated and more difficult to predict and control than are machines. Therefore, it may not surprise many that human error appears to be a dominant factor in aviation mishaps. The Defense Science Board — DoD's premiere body of scientific and technical advisors — found in 1997 that "Human performance is a causal factor in over 70% of all Class A mishaps."[34] As the following table suggests, human error (at least for the Navy and Marine Corps) may have had an even stronger influence on aviation mishaps in the time period 1997-2001.

Table 4. USN/USMC Class A Mishap Causal Factors (FY97-01)[35]

Factor	# Events	Rate	%
Human Error	114	1.52	86
Supervisory	91	1.21	69
Aircrew	88	1.17	67
Material	51	.68	39
Maintenance	18	.24	14
Facilities	13	.17	10

It appears that human performance affects all four Services more or less equally. The GAO found that "During Fiscal years 1994-95, human error was a factor in 71 percent of Air Force mishaps, 76 percent of Army mishaps, 74 percent of Navy/USMC mishaps."[36]

> The Army Safety Center stresses the impact of human error on aviation mishaps. When accident causes are examined, a major issue in aviation safety remains human error. Although training and leadership can often bear some of the responsibility, it is generally the case that soldier indiscipline, inattention, or the willful neglect of published rules or safeguards is cited as a contributing actor.[37]

According to the Army, between fiscal years 1999 and 2001, the leading causes of Army aviation accidents were: In-discipline (28.4%), Leadership (17.8%), Training (13.6%), and Standards (10.1%). Materiel failures, by comparison, caused

---

[34] Report of the Defense Science Board Task Force on Aviation Safety. February 1997. Office of the Undersecretary of Defense for Acquisition and Technology. Washington, D.C. February 27, 1997.

[35] Captain Kurt Garbow. Deputy Special Assistant for Safety Matters. OPNAV N09FB. "Naval Aviation Safety Briefing." February 28, 2002.

[36] "Military Aircraft Safety: Significant Improvements Since 1975." General Accounting Office. GAO/NSIAD-96-69BR. February 1996. P.24.

[37] *Flightfax* Aviation Safety Performance Review. May 28, 2002. U.S. Army. [http://safety.army.mil/home.html]

2.5% of accidents.[38] Army record indicate that "individual failure" (e.g. crew coordination, overconfidence, indiscipline) was a causal factor in 90.9% of Class A mishaps in FY03.[39] These figures lend credence to human error being a major and consistent cause of aviation accidents for all services.

The Coast Guard details some of the kinds of human errors that can lead to mishaps. In FY2001, for example, 89 percent of Coast Guard mishaps involved incomplete, improperly followed, inappropriate or unavailable procedures. Fifty five percent of mishaps involved inattention, complacency, or lack of awareness. Twenty five percent of mishaps involved incomplete checklists and poor communication. Workload, feeling rushed or having a lack of resources were mentioned in almost 40 percent of Coast Guard mishaps. Inexperience, lack of training, and inappropriate staffing were also factors in 40 percent of mishaps in FY2001.[40]

Congressional Considerations

Policy makers concerned about military aviation safety face two key questions. The first is philosophical: "What level of aviation mishaps is tolerable?" The second question is more practical: "What can be done to reduce aviation mishaps to that tolerable level?"

What level of aviation mishaps is tolerable?

There is no consensus among analysts nor policy makers on the state of military aviation safety. Many argue that the current mishaps rate is acceptable. They point out that: (1) military aviation operates under very trying circumstances, (2) DoD appears to make safety a high priority, (3) mishap rates have steadily declined over the last 50 years, and (4) contemporary mishap rates have been very low by historical standards. Others disagree, saying that the current mishap rate (an average of 1.7 Class A mishaps per 100,000 flight hours from 1990-2003) is too high.

Some observers say that DoD should strive toward a goal of zero aviation mishaps. Proponents of this perspective argue that there is no "acceptable" accident rate and a single accident or fatality is too high. People die in accidents, often needlessly, zero-mishap proponents say, and by focusing on rates and statistics, policy makers lose sight of this. They point out that although DoD's Class A mishap rate steadily improved between 1990 and 1996, for example, 777 people died and $9.42 billion in equipment was destroyed in aviation accidents.[41] The fact that the aviation mishap rate was the lowest ever, was little consolation to families who lost

---

[38] Army Safety Program. "4th Quarter FY01 Roll-Up." [http://safety.army.mil/home.html]

[39] "Human Error in Army Aviation Accidents." *Flightfax.* November 2003. p.4.

[40] *FY01 Aviation Safety Report.* U.S. Coast Guard. Health & Safety Directorate. Aviation Safety Division. P.11.

[41] Report of the Defense Science Board Task Force on Aviation Safety. February 1997. Office of the Undersecretary of Defense for Acquisition and Technology. Washington, D.C. February 27, 1997. p.ES-2.

loved ones in accidents during FY2000, zero-accident proponents say. The corrosive effects of aviation accidents on military readiness are well documented. By tolerating even one aviation accident, we unnecessarily hamstring the military, which is already facing serious challenges on the battlefield, they argue.

Others argue that while mishaps and especially mishap fatalities are unfortunate and to be avoided, some number of accidents is inevitable. Those who believe that low mishap rates are tolerable, point out that not even commercial airlines have achieved a zero mishap rate, despite considerably more benign flight conditions. Joining the military assumes some inherent risk. Low mishap rate proponents argue that the risk of accidents should be minimized, but will remain nonetheless. While striving for zero mishaps may be a worthy goal, it is unlikely to be achieved. Aviation safety can and should be improved by striving toward an ambitious, yet achievable goal. Some low mishap rate advocates point toward the commercial aviation major mishap rate of .033 per 100,000 flight hours as one benchmark.

What can be done to reduce aviation mishaps?

If policy makers wish to attempt to reduce aviation mishaps below their current rate, there appear to be four interrelated areas where action can be taken: leadership, organization, budget, and aggressive fielding of safety technologies.

Leadership. Considering the numerous, and often overlapping causes of military aviation mishaps, there is likely no single "silver bullet" that can significantly improve safety. However, many observers believe increased leadership on this issue may affect more mishap cause areas than any other single measure. Congress could consider requiring annual testimony on the status of military aviation safety to help motivate senior military leaders to take a more active role in promoting safety. The General Officers[42] who lead the Service safety centers might be directed to assess for Congress their Service's safety performance and make recommendations for improvements. Having the Service Chiefs, who are ultimately responsible for safety, testify would be another option.

As of October 2003, the DoD's recently established Defense Safety Oversight Council (DSOC) had held two meetings. To reflect this broad charter, the DSOC is divided into 10 task forces, which were established to "foster quick wins and other initiatives for implementation across DoD."[43] An Aviation Safety Improvements Task Force has been formed, and is chaired by Major General Ken Hess, Chief of Air Force Safety. The Aviation Safety Improvements Task Force's tasks are

> to recommend policies, programs, and investments to reduce aircrew fatalities, injuries and aircraft accidents. Assess, review, and advise on improving all aspects of existing/proposed aviation safety programs such as: Military Flight

---

[42] The Marine Corps Safety Center is headed by a Colonel. The other Safety Centers are run by one or two star General Officers.

[43] *DSOC Task Forces*. October 6, 2003. Briefing found at DUSD (I&E) website. [https://www.denix.osd.mil/denix/Public/ES-Programs/Force/Safety/measure_merit.html]

> Operations Quality Assurance (MFOQA), Human Systems Integration, Other Aviation Safety Systems.[44]

The DSOC appears to have a clear and direct lineage to DoD's top leaders. Monitoring the progress of the Aviation Task Force, and the implementation of its findings and recommendations may be an on-going focus of congressional oversight.

Organization. It is difficult for leaders to affect change if they do not have the organizational instruments to implement revised policies and procedures. Currently, two organizational issues stand out in the area of military aviation safety. First, the Office of the Secretary of Defense (OSD) is responsible for setting safety policies and providing oversight. However, there is not one individual in OSD whose sole responsibility is military aviation safety. GAO recognized this shortcoming in a January 2002 report:

> The office responsible for aviation safety currently occupies a relatively low organizational position within the Office of the Secretary of Defense (OSD). As a result of downsizing by OSD several years ago, five safety positions, which shared responsibility for aviation safety issues, were abolished and a single staff member hired. This staff member's responsibilities include aviation safety and a number of other responsibilities, including compliance with the Occupational Safety and Health Act of 1970 (OSHA), as amended; fire and emergency services; range and weapons safety; and traffic transportation.[45]

According to former OSD employees, at one time up to eight people in OSD worked exclusively on military aviation safety issues. If the current state of staffing inhibits OSD's ability to effectively execute its responsibilities in aviation safety, that may suggest that OSD leaders do not place a high priority on this issue.

The second organizational issue pertains to the Joint Staff and the Combatant Commands.[46] Currently, none of these organizations play a significant role in promoting aviation safety or investigating mishaps. The Services, through their safety centers, conduct investigations, record and report mishaps, and generally promote aviation safety. However, DoD's guiding policy document on accident investigation, reporting and record keeping (DoD Instruction 6055.7, updated October 3, 2000) applies to the Joint Staff and the CINCs as well as the Services (Section 2 "Applicability and Scope."). This suggests that the Joint Staff and CINCs have the authority, and perhaps the responsibility to take a more active role in aviation safety.

It is likely that the Services, and perhaps the Joint Staff and CINCs themselves, would resist increased Joint Staff/CINC participation in the safety process. However, it may be useful to explore what roles these organizations could play either to

---

[44] *Ibid*

[45] "Aviation Safety: FAA and DoD Response to Similar Safety Concerns." General Accounting Office. GAO-02-77. January 2002. p.3.

[46] Known as CINCs (for commanders in chief), examples include, U.S. European Command, U.S. Central Command, and U.S. Pacific Command.

augment or even compete with the Service's safety processes. For example, could and should CINC's take an active part in investigating mishaps that occur in their geographic area of responsibility (AOR)? Are peculiar safety factors adequately considered when planning specific operations and exercises in their AORs? Could and should the Joint Staff take an active role in investigating accidents that involve more than one Service? Could and should the Joint Staff promote more standardized mishap recording and reporting among the safety centers?

Budget. Policy makers who wish to promote aviation safety may review three interrelated aspects of DoD's budget. First, a review of DoD's FY2004 budget request suggests that compared to the billions of dollars that are spent annually to repair or replace aircraft damaged or lost in mishaps, DoD requests little specifically for aviation safety. The Air Force — under the heading "Personal Safety and Rescue Equip." — requested $12.7 million in procurement ($5.3 million for "Night Vision Goggles", and $7.4 million for "Items Less than $5,000,000) and the Navy requested $105 million in O&M funding for aviation safety related activities. There was no request for research into aviation safety.[47] Many may argue that money spent on aviation safety will pay for itself in savings from reduced accidents.

It may be difficult for safety proponents to argue that the Services are spending too little on aviation safety, however, because of the second budget issue, which is that safety related equipment and initiatives are spread throughout the Services budgets, and at low levels of documentation. Aviation safety programs are not aggregated at a level that facilitates their identification, review and assessment. Many more Air Force programs than those mentioned above may contribute to aviation safety but are likely "buried" in the budget; aggregated under budget activities and line items such as "Aircraft Procurement," "Modification of Aircraft," or "Support Equipment and Facilities."

The third budget issue is that because of this "dis-aggregation" of aviation safety programs and efforts, safety does not compete well with other programs in the annual budget process. According to the Defense Science Board:

> It appears that, because of budget procedures, military Services are not currently motivated to invest in safety technology that is likely to avoid down-stream loss of life and equipment, especially in non-combat aircraft. The emphasis has been and continues to be on equipment directly related to combat missions along with minimizing initial unit cost.[48]

---

[47] *Procurement Programs (P-1)* Department of Defense Budget Fiscal year 2004. February 2003. Office of the Under Secretary of Defense (Comptroller). *Operation and Maintenance Programs (O-1).* Department of Defense Budget for Fiscal Year 2004. February 2003. *RDT&E Programs (R-1).* Department of Defense Budget for Fiscal Year 2004. February 2003 Office of the Under Secretary of Defense (Comptroller).

[48] Report of the Defense Science Board Task Force on Aviation Safety. February 1997. Office of the Undersecretary of Defense for Acquisition and Technology. Washington, D.C. February 27, 1997. P.14.

Those wishing to promote aviation safety may look for ways to help safety programs and initiatives compete with other programs and to help the Services appreciate the long term benefit of spending near term dollars on safety.

In considering measures that might ameliorate these concerns, a possibility would be to "fence off" money in DoD's budget specifically for aviation safety initiatives and programs. There is precedent for this kind of action. In their markup of DoD's FY2001 request, appropriations conferees adopted a Senate proposal to create the National Defense Airlift Fund. The purpose of this fund was to recognize airlift as an asset that benefits all the Services, and to protect airlift money from competition with other programs (such as fighter aircraft) in the Air Force budget.[49] Congress might weigh creating a Military Aviation Safety Fund to provide resources and focus for basic and applied research on aviation safety on potentially high leverage topics such as better understanding of human performance and human error.

Some would oppose creating a fund in DoD's budget specifically for aviation safety, arguing that there are higher safety priorities. They point out that there are more Class A accidents on the ground and more fatalities than there are in the air. For FY2002 and FY2003, for example, Army aviation experienced 11 flight and non-flight Class A mishaps and 13 fatalities. During that same time period, the Army experienced 99 ground Class A mishaps (on and off duty), resulting in 97 fatalities.[50] During FY03, the Marine Corps suffered 11 Class A flight mishaps, resulting in 16 fatalities. During this same time period, 107 Marines died in 97 ground mishaps. [51] If any area should be singled out for special attention, some argue, it should be ground safety, not aviation safety.

Another option would be to tie the procurement of new aircraft to the desired Class A mishap rate. (This assumes that zero is not the desired rate.) The following fictional scenario illustrates how this measure might work: In their FY20XX budget, the Navy requests 40 new F/A-18E/F aircraft. Ten of these requested aircraft would replace aircraft lost to Class A mishaps, which occurred at a rate of 2.0 per 100,000 flight hours. Safety advocates believe that this mishap rate is too high, and could be cut in half (1.0 per 100,000 flight hours). Therefore, funds would be provided for only half the replacement aircraft (five), to encourage the Navy to reduce mishaps in the future. An incentive option would be to transfer the funding requested for the remaining five replacement aircraft to the Military Aviation Safety Fund.

This option could also encounter resistance. Some may oppose this approach because it appears to legitimize some level of mishaps. In the fictitious scenario above, a Class A mishap rate of 1.0 per 100,000 flight hours is considered "ok" or even desirable. This would be particularly distasteful to zero-mishap proponents. Others would oppose the strategy of linking aircraft procurement to a low mishap rate

---

[49] See CRS Report RL30685, *Military Airlift: C-17 Aircraft Program* for additional information.

[50] U.S. Army Safety Center. *Quarterly Report*. February FY2003. [http://safety.army.mil/ipr/index.asp]

[51] *USMC Safety Statistics*. U.S. Marine Corps Safety Division. [http://www.hqmc.usmc.mil/safety.nsf/$about?OpenAbout]

because they believe that it would result in a tangible loss of near term combat capability (aircraft) with no guarantee of improved safety in the future. Application of such measures would likely be subject to a comparison between the potential safety benefits gained and the operational capabilities lost or deferred.

Safety Technology. Many have argued that military aircraft do not tend to employ the same safety equipment as found in the civil sector, and that the Services tend to field safety equipment years after it is fielded in the civil world. According to one aviation safety law professor "military aviation lacks some of the essential safeguards of civil aviation."[52] The GAO found that the FAA mandated commercial aircraft employ two key safety technologies — Ground Proximity Warning Systems and Traffic Alert and Collision Avoidance Systems — decades before DoD began employing similar systems.[53]

Both the Defense Science Board and a government/industry Commercial Aviation Safety Team have drafted "short lists" of the safety technologies they believe would most improve safety in military and commercial aviation respectively. The Defense Science Board recommended DoD more aggressively invest in ground collision avoidance systems, flight data and cockpit video recorders, tactile situational awareness system (TSAS), night vision devices, and wind shear detection systems.[54] A recently completed Commercial Aviation Safety Team study assessed 700 safety technologies over five years and recommended 16 high impact proposals in the areas where mishaps most frequently happen: loss of control, approach and landing, and runway incursions.[55]

The Services offer several arguments for why military aircraft do not always field the same safety equipment as found on commercial aircraft. Lack of funds is one argument, degradation of aircraft performance is another. However, Congress could evaluate the applicability of the new FAA safety recommendations to military operations, and weigh the soundness of Service arguments with other issues discussed in this report. For example, can investments in safety today achieve cost savings in the future?

---

[52] Russell Carollo. "31 Dead in Military Aviation Accidents Since Oct. 1." *Dayton Daily News.* March 3, 2002.

[53] "Aviation Safety: FAA and DoD Response to Similar Safety Concerns." General Accounting Office. GAO-02-77. January 2002. p.47-51.

[54] Defense Science Board op cit. p.35.

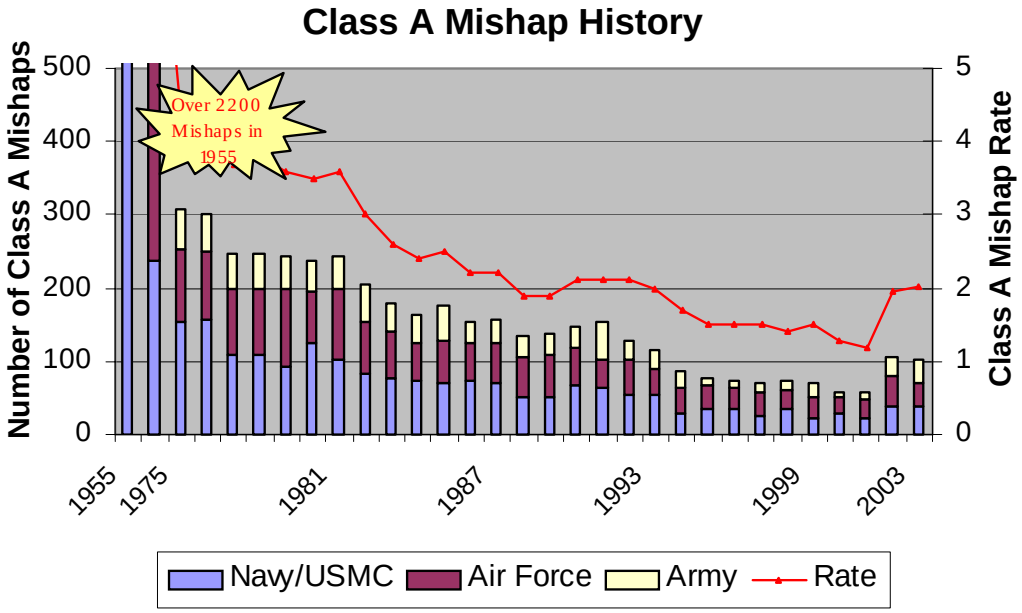
[55] See Appendix III for specific recommendations.

Appendix I. DoD Safety Information and Points of Contact

- **DoD**
  [https://www.denix.osd.mil/denix/Public/ES-Programs/Force/force.html]
- **U.S. Army Safety Center** [http://safety.army.mil/home.html]
- **U.S. Navy Safety Center** [http://www.safetycenter.navy.mil/]
- **U.S. Air Force Safety Center** [http://safety.kirtland.af.mil/]
- **U.S. Marine Corps**
  [http://www.hqmc.usmc.mil/safety.nsf/$about?OpenAbout]
- **U.S. Coast Guard Aviation Safety Division**
  [http://www.uscg.mil/hq/g- w/g-wk/g-wks/g-wks-1/wks1.htm]

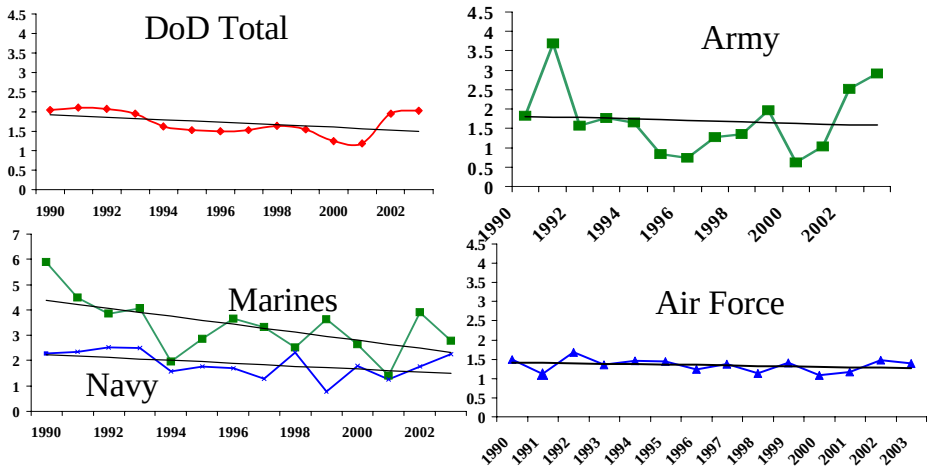
Appendix II. Flight Accident Trends

Figure 3. Number and Rate of Class A Mishaps, 1955-2003



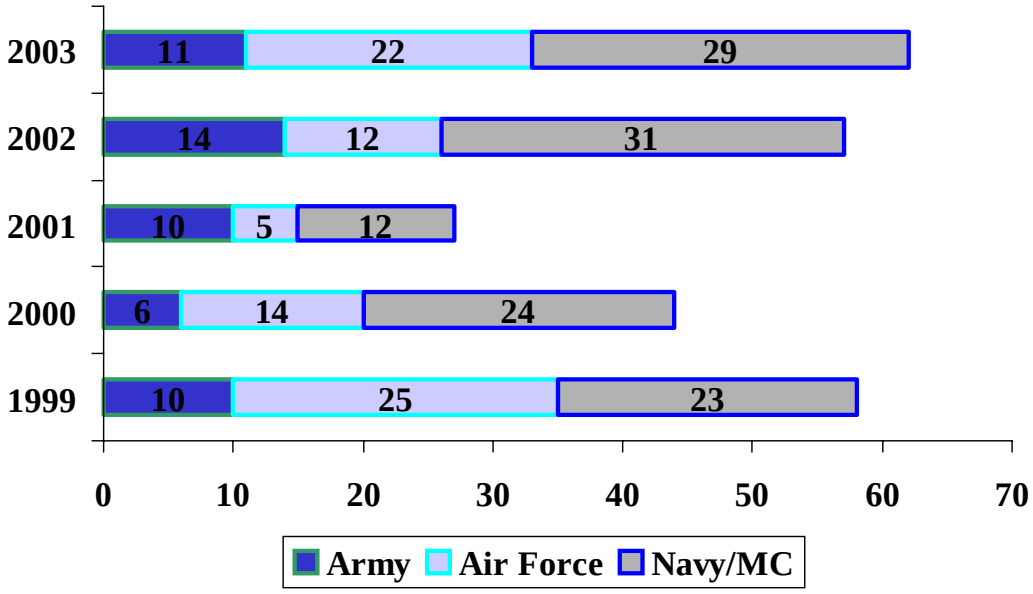
Source: Institute for Defense Analyses chart, prepared for Assistant Deputy Undersecretary of Defense (Safety & Occupational Health). Updated by CRS.

Figure 4. Class A Aircraft Mishap Rate
(Includes OEF and OIF)



Source: U.S. Military Accident Statistics as of November 4, 2003. Deputy Undersecretary of Defense for Installations and Environment (DUSD(I&E))
[https://www.denix.osd.mil/denix/Public/ES-Programs/Force/Safety/measure_merit.html]

Figure 5. Aircraft Destroyed, FY99-FY03



Source: U.S. Military Accident Statistics as of November 4, 2003. Deputy Undersecretary of Defense for Installations and Environment (DUSD(I&E)) [https://www.denix.osd.mil/denix/Public/ES-Programs/Force/Safety/measure_merit.html]

Appendix III. Commercial Aviation Safety Team Recommendations[56]

Recommended Safety Priorities for Air Carriers — 2002

Loss-of-Control (LOC)

- Implement ground and flight simulator training of advanced maneuvers LOC
- Prioritize safety information via a risk assessment of service bulletins and other critical information.
- Develop processes to ensure essential operating information gets to operations and maintenance workers
- Incorporate FOQA, AQP and ASAP to help pilots attain maximum proficiency
- Develop a training aid that consolidates human factors knowledge of automation and CRM.
- The FAA should consider revising guidance material for flight crew SOPs.

Approach and Landing Accident Reduction (ALAR)

- Use design guidance to ensure flight critical system components incorporate fault-tolerant design principles and are tested and analyzed appropriately
- Issue guidance to ensure maintenance of flight critical system components does not reduce or compromise design level of safety
- Incorporate approach and landing training into flight crew qualification programs.

Runway Incursions (RI)

- Airports or the FAA should fund "variable message signs" that provide a visual signal of whether a runway is safe to enter or cross
- The FAA should develop active and/or passive airport surveillance technologies (Both ground- and aircraft-based) to provide conflict-alerting capabilities at all towered airports.
- Develop SOPs for the ground movement portions of flight operations and incorporate into policy manuals and training programs.
- Incorporate RI training into flight crew qualification, approved training or other pilot training programs
- Develop "best practices" material for single-pilot general aviation aircraft ground operations
- Develop "best practices" material for mechanics or others who tow aircraft in the airport movement area.
- Develop "best practices" material for vehicle operators in the airport movement area.

---

[56] John Croft. "2002 Safety Upgrades Sparse by Affordable." *Aviation Week & Space Technology*. August 26, 2002.

More information about the Commercial Aviation Safety Team can be found at: [http://www.aia-aerospace.org/departments/civil/cast/]