RECOMMENDATIONS FOR IMPROVING THE U.S. ARMY'S AVIATION ACCIDENT REPORTING AND CLASSIFICATION SYSTEM

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This paper outlines the U.S. Army's Aviation Accident Reporting and Classification system, highlighting the policies and procedures currently in place, and makes several recommendations for changing the regulatory guidelines. Specifically, we analyze the accident classification levels and the dollar cost hierarchy of Class A through E aviation accidents. The average cost of a modern Army aircraft, whether fixed or rotary-wing, is well over $15 Million, and the classification levels have simply not kept pace. Additionally, we suggest that the Army should explicitly adopt and include the Human Factors Analysis and Classification System (HFACS) to their accident analyses. The Army's last set of safety regulations regarding accident reporting was published well over 10 years ago, and although the Army has merged both ground and aviation safety into the newly-formed Combat Readiness Center (CRC), there remain several improvements that can be made. While current policies and procedures in effect do not necessarily underestimate the significant cost of the Army's aviation accidents, restructuring of the classification levels to bring those more in line with the increasing cost of modern equipment, and the addition of HFACS considerations to accident reporting are both needed in order to provide leaders, policy makers and investigators alike better information in the 21st Century.

Introduction

Aviation is a high risk enterprise, and perhaps no segment of the modern-day aviation industry is as risky as military aviation. Indeed, during periods of increased military activity, the U.S. Army exceeds all of the nation's other military services in terms of aviation accident rates (GAO, 1998; CRC, 2006). During Fiscal Year 2006, the Army's Class A-C accident rate was 7.56 per 100,000 flying hours (CRC, 2006). However, this heightened accident rate must take into consideration the U.S. Army's extremely high current operational tempo. The Army has been engaged in warfare in both Iraq and Afghanistan, and aviation units have been deployed worldwide. Also, Army helicopter pilots must typically perform dangerous Nap of the Earth (NOE) flight mission profiles wherein a helicopter travels below tree height at varying airspeeds, using natural environmental features to provide camouflage, and often in unfamiliar, hostile environments.

Due to this, the Army has a comprehensive aviation accident investigation and reporting system, outlined in AR (Army Regulation) 385-40 (1994), which involves leaders at all levels of the chain of command. In addition, the Army's Safety Center at Fort Rucker, recently renamed the Combat Readiness Center (CRC), serves as the collecting and disseminating agency, emphasizing accident prevention as vital toward winning our nation's wars. The CRC was given the mission to collect, synthesize and distribute information regarding all aspects of Army accidents, on the ground as well as in the air. Developing a centralized reporting agency such as the CRC, and distributing awareness for the troops as to the causes of accidents has been a remarkable tool for the modern soldier. The CRC provides secure website access to accident reports, statistics and analyses, as well as sharing strategies to prevent similar accidents from happening in the future. However, one aspect of the Army's aviation accident reporting and classification system has not evolved. The tiered hierarchy of classifying accidents as Class A through E has not kept pace with the increasing cost of the Army's aircraft. According to a 2006 Department of Defense (DOD) Selected Acquisition Report (SAR), modern Army aircraft average close to $20 Million a piece. Equipment costs continue to increase due to inflation, maintenance, acquisition of new technology, and several other factors such as fielding and training. A change to the existing US Army aviation accident severity classification thresholds reflecting the increased costs associated with the current inventory's advanced airframes is proposed. Additionally, it is suggested the Army adopt the Human Factors Analysis and Classification System (HFACS) into mainstream operations.

Originally developed for the Navy/Marine Corps as an accident investigation and analysis tool (Wiegmann & Shappell, 2003), HFACS would provide much-needed causal insight for aviation accident investigations in the Army, as well. HFACS,

itself adopted from James Reason's model of accident causation (Reason, 1990), has four levels of analysis: Unsafe Acts, Preconditions for Unsafe Acts, Unsafe Supervision, and Organizational Influences. Each one of these levels is further broken down into sub categories (see below), allowing the accident investigator to clarify the comprehensive picture of contributing factors.

The HFACS Taxonomy:

I. Unsafe Acts
   a. Errors
      i. Skill Based Errors
      ii. Decision Errors
      iii. Perceptual Errors
   b. Violations
      i. Routine
      ii. Exceptional
II. Preconditions for Unsafe Acts
   a. Environmental Factors
      i. Physical Environment
      ii. Technological Environment
   b. Personnel Factors
      i. Crew Resource Management
      ii. Personal Readiness
   c. Condition of Operators
      i. Adverse Mental States
      ii. Adverse Physiological States
      iii. Physical/Mental Limitations
III. Unsafe Supervision
   a. Inadequate Supervision
   b. Planned Inappropriate Operations
   c. Failure to Correct Problem
   d. Supervisory Violations
IV. Organizational Influences
   a. Resource Management
   b. Organizational Climate
   c. Organizational Process

Utilizing HFACS, Army accident investigators, leaders and policy-makers alike may gain a more complete understanding of not only what happened, but why it happened, and steps to mitigate future accident reoccurrence.

The U.S. Army's Aviation Accident Reporting System

Since the Army's primary mission of ground combat involves equipment that is mostly land-based, the regulations pertaining to accident reporting involve mostly ground systems. However, there are several sections within AR 385-40: "Accident Reporting and Records" relating to aviation safety specifically (pages 10-13, 1994). At the individual unit level, an Aviation Safety Officer (ASO), typically a Warrant Officer, bears responsibility for the training, prevention and reporting of any aviation accident. The Warrant Officer develops a safety plan of action, and advises the commander on such issues as crew rest and risk management. When an accident/incident occurs, several things arise immediately (AR 385-40 Chapter 3): the scene of the accident/incident is secured, the aviation mission brief sheet (which details the Chain of Command's involvement) is secured at the unit's Flight Operations, any flight crew and personnel involved are handled (e.g. flight crew must submit to blood/urine samples, if appropriate), and preliminary data collection begins. After this standardized immediate reaction to an aviation accident/incident, the unit Commander and Safety Officer must submit a report up the Chain-of-Command to the appropriate level. Depending on the severity of the accident/incident, as well as the operational climate of the mission (peacetime or combat), the ASO prepares an Abbreviated Aviation Accident Report (AAAR) on DA FORM 2397-AB-R, and submits it through the chain-of-command. This report, which has a suspense of no more than 90 calendar days, determines the accident's classification level. Depending on the severity of the accident (which is assigned a Class A-E designation), the AAAR may be submitted telephonically/electronically to the CRC. After the AAAR is received, the CRC is responsible for conducting detailed investigations and attributing causality to the only the most serious accidents (Class A through C). These detailed investigations involve a team of senior aviation safety officers from the CRC, and may include taking witness statements, evaluating the Flight Data Recorder (FDR)/Cockpit Voice Recorder (CVR), Standard Operating Procedures (SOPs) in effect at the accident unit, establishing crew rest and pre-mission planning adequacy, as well as several other factors (AR 385-40, pp 11-13). The CRC website has published several guidebooks and handouts to help unit leaders and investigators prepare and analyze accident reports, including one titled "Abbreviated Aviation Accident Report use and Preparation Guide" (2005), but interestingly, none of them apply HFACS considerations.

Aviation Accident Types and Severity Classification Levels

The Army's aviation safety regulations contain specific guidance on the types and severity classification levels assigned to aviation accidents. AR 385-40 defines three types of accidents/incidents in Army Aviation (1994: Chapter 2-4, pp 4-5). Of

note is the distinction, similar to the FAA and NTSB, regarding the "intent for flight":

1. **Flight:** An aviation flight accident is one in which intent for flight exists and there is reportable damage to the aircraft itself. Intent for flight begins when aircraft power is applied, or brakes released, to move the aircraft under its own power with an authorized crew. Intent for flight ends when the aircraft is at full stop and power is completely reduced. Aviation accident rates are calculated only on aviation flight accidents. Rates are based on number of occurrences per 100,000 hours flown.
2. **Flight-Related:** An aviation flight-related accident is one in which intent for flight exists and there is *no* reportable damage to the aircraft itself, but the accident involves a fatality, injury to air crew, ground crew, or passengers, or other property damage. These accidents are not used in the calculation of flight accident rates.
3. **Ground:** An aviation ground accident is one in which the engine(s) is/are in operation and intent for flight *does not* exist and there is injury or property damage involving an Army aircraft. These accidents are not used in the calculation of flight accident rates.

These distinctions provide adequate qualitative categorization, but do not provide any sort of quantitative classification. The regulations provide substantial clarification and detailed criteria, however, for accident/incident classification by assigning damage amounts (cost) and injury levels to several classes (Table 1). It is important to note that this classification is based solely on the aggregate property damage or injury/illness severity resulting from the accident itself, and not the longer-term injury costs such as hospitalization, medication or surgery. Another important distinction to make is that these classification levels apply to all accidents involving Army equipment, and not solely aviation accidents. In addition, the requirements for notification, reporting methods, and the suspense for completion, vary widely among the accident and incident classes, and even differ between peacetime and combat operations.

The Army's regulations also provide explicit guidance on computing accident costs. For example, in AR 385-40, costs distinct to aviation accidents include:

- Destroyed, missing or abandoned aircraft cost (ECOD)
- Army parts replacement cost (from Army Master Data File – AMDF)
- Repair cost
- Direct man-hour costs (labor at $16 / man-hour) and
- Replacement of damaged components (some major components are automatically 15% of unit cost, including tail booms, empennages, wings, fuselage, main rotor heads, transmission or gearbox(es), vertical stabilizer; a damaged aircraft engine is computed at 17% of unit cost).

However, the total cost of aviation accident damage does not include:

- Credit taken for the estimated scrap value or turn-in of parts that can be reused
- Fair Wear and Tear (FWT), including subsequent damage to a component due to a previously failed one, damage incurred solely from flying debris during operations in confined areas and unimproved landing sites, and anything discovered during regular preventative maintenance, and Combat Loss (direct action from the enemy). (1994; Chapter 2, pp 4-9).

Table 1. Current Army Aviation Accident Classification Levels (AR 385-40, 1994)

Class A Accident	The resulting total cost or reportable damage is $1,000,000 or more, an Army aircraft is destroyed, or an injury and/or occupational illness results in a fatality or permanent total disability.
Class B Accident	The resulting total cost of reportable property damage is $200,000 or more but less than $1,000,000, an injury and/or occupational illness results in permanent partial disability, or three or more personnel are hospitalized as inpatients.
Class C Accident	The resulting total cost of property damage is $20,000 or more but less than $200,000, a nonfatal injury causes any loss of time from work beyond the day or shift on which it occurred, or a nonfatal illness or disability causes loss of time from work or disability at any time (lost-time case).

Class D Accident	The resulting total cost of property damage is $2,000 or more but less than $20,000, or a nonfatal injury that does not meet the criteria of a Class C accident (no-lost-time case).
Class E Incident	The resulting cost of property damage is less than $2,000. Mission is interrupted or not completed. Intent for flight may or may not exist.
Class F Incident	Foreign Object Damage (FOD). Reportable damage confined to turbine-engines as a result of unavoidable internal or external FOD, regardless of cost.

This explicit computational guidance allows individual unit leaders the ability to minimize the actual cost of aviation accidents by applying credit for parts turned in, with no associated application of the much larger-scale cost of decreasing mission viability. Under the current regulations, subordinate commanders can reduce the total cost of damage by turning in components to the supply system, and receiving credit. The assigned percentages of major aircraft components may be lower than the actual cost of those components, thereby effectively reducing the total damage cost. An example would be the cost computation for a damaged aircraft engine which must go to depot-level for repair at 17% of the unit cost (AR 385-40, page 8).

Suggestions for Improvement

The Army's classification system provides an orderly way to categorize the severity and cost of aviation accidents and incidents, but can be enhanced in several ways. Firstly, the cost of damage levels for Class A through E should be increased significantly, by my estimates approaching 500%. These new damage cost amounts are in relative proportion to the increased cost of aircraft in the current inventory, in addition to the overall much higher cost of aircraft when compared to other Army equipment subject to the same regulations. It has been close to 15 years since the accident classification levels were first introduced in the early 1990s. An excellent example of the increased cost of modern aircraft when compared to legacy aircraft and other Army equipment would be the AH-64D Apache Longbow attack helicopter, which cost well over $21 Million per unit. When the Apache Longbow is compared to the much older UH-1 Iroquois "Huey" troop/cargo carrier, which cost just over $1 Million (CBO, 1995), a clear case for increased classification levels can be seen. Secondly, a consideration for the projected time an aircraft will remain Non-Mission Capable (NMC) due to anticipated repairs or supply backlogs should be added. By adding a criterion related to aircraft down-time, the associated cost of failure to make mission due to equipment shortage or maintenance delays can be captured. Often, repairs to accident aircraft require depot-level maintenance, which take the aircraft out of the unit's flyable inventory for a long period of time. The ability to complete the mission could be severely impacted by the loss of use of even a single aircraft. These NMC times should be graduated in a proportional scale to the damage cost values with each class of accident severity. For example, if a unit was forced to account for the inability to complete missions over an extended period of time due to an aircraft undergoing repairs after an accident, the greater cost to the Army at the loss of such a combat multiplier might be appreciated

Additional scrutiny is needed regarding the practice of turning in salvageable equipment to reduce the actual property damage cost. In too many cases, this practice has the potential to significantly limit the visibility criteria the classification system intends to provide. If subordinate leaders are authorized to reduce the cost of an accident by excluding the cost of man-hours to repair the aircraft, and are allowed to turn in pieces of equipment for salvage credit, in an effort to reduce the final actual cost of damage (ACOD), upper-echelon leaders and policy makers may not be afforded the opportunity to see the true (rising) cost of aviation accidents.

The personal injury classifications used in assigning severity levels to aviation accidents should remain unchanged. Furthermore, all accidents resulting in the destruction of an aircraft should remain reported as Class A.

By refocusing the classification levels specifically on Army aircraft, changing the cost values associated with each aviation accident severity classification in accordance with the increased cost of modern machines, and the addition of considerations for projected maintenance down-time, the true impact to successful and continued mission accomplishment can be captured.

Implementing the Human Factors Analysis Classification System (HFACS)

The U.S. Navy has adopted the HFACS as a helpful tool in analyzing the causes and preconditions for accidents. The Army could benefit from implementing the HFACS model for accident

analyses. By teaching the basic HFACS considerations to young leaders and safety officers, the Army could effect gradual change in its organizational climate of safety. If the CRC were to adopt the HFACS framework in accident analyses, for both ground and aviation accidents, greater emphasis could be placed on investigating the multi-layered components of human error. The Army might be forced look deep within itself, and critique current policies and procedures, but the benefits would be a safer and more effective fighting force for the 21st Century.

Proposed New Class A Accident	An Army aircraft is destroyed, an injury and/or occupational illness results in a fatality or permanent total disability, the resulting total cost of reportable damage is $5,000,000 or more, or the (projected) aircraft Non-Mission Capable down-time exceeds 8 weeks.
Proposed New Class B Accident	The resulting total cost of reportable property damage is $1,000,000 or more but less than $5,000,000, an injury and/or occupational illness results in permanent partial disability, three or more personnel are hospitalized as inpatients, or the (projected) aircraft Non-Mission Capable down-time exceeds 4 weeks..
Proposed New Class C Accident	The resulting total cost of property damage is $75,000 or more but less than $1,000,000, a nonfatal injury causes any loss of time from work beyond the day or shift on which it occurred, a nonfatal illness or disability causes loss of time from work or disability at any time, or the (projected) aircraft Non-Mission Capable down-time exceeds 2 weeks.
Proposed New Class D Accident	The resulting total cost of property damage is $10,000 or more but less than $75,000, a nonfatal injury that does not result in any loss of time from work, or the (projected) aircraft Non-Mission Capable down-time exceeds 5 days.
Proposed New Class E Incident	The resulting cost of property damage is less than $10,000. Mission is interrupted or not completed. Intent for flight may or may not exist.

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