General Aviation

Title: Ultra-fine grained human factors analysis of selected aircrew errors

Description of Requirements:
As part of the FAA's endeavor to better understand the human causes of GA accidents, the FAA/Civil Aerospace Medical Institute (CAMI) and the University of Illinois have analyzed fifteen years (1990-2004) of general aviation (GA) accidents using the Human Factors Analysis and Classification System (HFACS). The findings have identified that among the unsafe acts of aircrew, skill-based errors account for roughly 3 out of every 4 accidents, followed by decision errors (28%), violations (13%), and perceptual errors (5%). In the last collaborative effort, these analyses were extended to identify the general types of errors within each causal category (i.e., a fine-grained analysis of GA accidents). For example, it was determined that the top skill-based errors included technique errors such as the loss of directional control on the ground, management of airspeed, loss of control in-flight, and compensation for winds. While these analyses provide the most comprehensive examination of the human causes associated with GA accidents to date, more information about the specific operational and individual pilot factors associated with each unsafe act is needed to generate targeted interventions. As a result, AFS-800 has requested that a more in-depth "ultra" fine-grained analysis be performed on the top aircrew unsafe acts so that effective interventions can be developed as part of requirement entitled "A New Approach to Aviation Accident/Incident Prevention/Mitigation".

Background:
Several previous studies have been performed to examine the factors associated with general aviation accidents. However, most of these efforts have focused almost exclusively on contextual factors and/or pilot demographics, rather than the underlying causes of the accidents. While no one disagrees that factors like weather (e.g., IMC versus VMC), lighting (e.g., day versus night), and terrain (e.g., mountainous versus featureless) contribute to accidents, pilots have little, if any, control over them. Likewise, knowing a pilot's gender, age, occupation, or flight experience, contributes little to our ability to prevent GA accidents. After all, just because males may have a higher accident rate than females, or pilots with fewer that 500 flight hours have a higher risk of accidents, what are we to do? Can we restrict males from flying or require pilots to have more than 500 flight hours before they are granted a certificate? Hence, when such contextual and demographic information is considered in isolation, apart from any data concerning underlying causal factors (i.e., information

about why the accident happened), it provides little in the way of preventing accidents. At best, it simply allows the identification of target populations for the dissemination of safety information.To address this issue, the Human Factors Analysis and Classification System (HFACS) was developed to identify the underlying human causal factors associated with aviation accidents. HFACS is a theoretically based tool for investigating and analyzing both latent and active failures associated with pilot-error related accidents. Previous research has shown that HFACS can be reliably used with commercial and general aviation accidents/incidents to analyze underlying human factors. Our previous analyses have identified general trends in the types of human errors that have contributed to civil aviation accidents, as well as the types of errors committed and the relative importance of each error type in the genesis of accidents.Using records maintained by the National Transportation Safety Board and the FAA, seven pilot subject matter experts used HFACS to determine the global human error categories associated with each human causal factor for each aviation accident occurring between 1990-2000. In total, over 17,000 accidents were associated with human error were examined, yielding nearly 35,000 causal factors. The result of these analyses revealed that aircrew skill-based errors were the most frequent unsafe act identified within the accident data and were associated with nearly 80% of all GA accidents followed by decision errors (30%), violations (14%) and perceptual errors (6%). Note that the percentages do not add up to 100% because accidents are associated with multiple cause factors. The same is true if one examines the seminal error in the chain of events (skill-based errors 61%; decision error 19%; violation 8%; perceptual error 4%). Upon closer examination, the most frequently cited skill-based errors involved directional control on the ground, aircraft control in the air, airspeed, and compensation for winds. The top decision errors involved in-flight planning/decision making, takeoff/landing from unsuitable terrain, fuel related issues, and pre-flight planning/decision making. The top violation involved VFR flight into IMC, which also accounted for the largest portion of fatal accidents.These analyses reflect the most comprehensive examination of human causes associated with GA accidents to date, and provide valuable insight into where interventions need to be focused to improve safety. However, like analyses of demographic variables, analysis of human causal factors in isolation, independent of the context in which they occur, also provides only limited information. What is now required is a systematic integration of both causal and contextual information (i.e., operational and pilot demographic information), so that the complete picture of GA accidents can be developed and effective interventions deployed. For example, one of the top skill-based errors identified in previous HFACS analyses was the pilot’s

“failure to compensate for winds.” Hence, in order generate an effective intervention strategy to address this issue, information about the operational and personal pilot factors is needed. In particular, do accidents associated with inadequate wind compensation occur during cross wind landings, around mountainous terrain, or in particular types of aircraft? Do they involve low time pilots, or those who are inexperienced with a particular airstrip or geographic region or, perhaps recently transitioned to a different aircraft? When these traditional demographic questions are linked with the results of the previous in depth HFACS analysis of aircrew causal factors, a complete understanding of the threats to general aviation safety can finally be realized. As a result, AFS-800 has requested that this more in-depth “ultra” fine-grained analysis be performed on the top aircrew errors and violations so that effective interventions can be developed in conjunction with requirement #947 “A New Approach to Aviation Accident/Incident Prevention/Mitigation”.

Output:
A detailed analysis of the operational and pilot data related to each of the different HFACS categories (decision, violations, skill-based, and perceptual errors) to determine the exact nature or causal envelope surrounding each aircrew unsafe act.

Regulatory Link:
FAA Flight Plan Increased Safety: Objective 2: Reduce the Number of Flight Accidents in General Aviation. Objective 3: Reduce Accidents in Alaska. 2005 AVR Business Plan: Strategic Initiative: Human Factors, Strategic Initiative: Human Factors Comparison and Analysis.