CREW DECISION MAKING UNDER STRESSS. J. Organiz. NASA Ames Research Center, Moffett Field, CA 94035

INTRODUCTION: Flight crews must make decisions and take action when systems fail or emergencies arise during flight. These situations may involve high levels of risk, information uncertainty, and time pressure, factors that contribute to stress. Full-motion flight simulation studies have shown that crews differ in how effectively they cope in these circumstances, judged by operational errors and crew coordination. The present study analyzed the problem solving and decision making strategies used by crews in three different threat levels over 112 days. The data includes 21 abnormal events that required decisions during high workload periods. Transcripts of videotapes were analyzed to describe decision making strategies. Crew performance (errors and coordination) was judged on-line and from videotapes by check airman.

RESULTS: Based on a median split of crew performance errors, analyses to date indicate a difference in general strategy between operators who make more or less errors. Higher performing crews showed greater situational awareness—they responded quickly to cues and interpreted them appropriately. They requested more decision-relevant information and took into account more flight-phase goals. Lower performing crews showed poorer situational awareness, planning, constraint sensitivity, and coordination. The major difference between higher and lower performing crews was that lower crews made quick decisions and then collected information to confirm their decision.

CONCLUSION: Differences in overall crew performance were associated with differences in situational awareness, information management, and decision strategy. Operator characteristics were associated with these differences, a finding with implications for crew selection and training.

COGNITION AND PROCEDURE REPRESENTATIONAL REQUIREMENTS FOR PREDICTIVE HUMAN PERFORMANCE MODELS. K. Kocur

NASA Ames Research Center, Moffett Field, CA USA

Models and modeling environments for human performance are becoming significant contributors to early system design and analysis problems. Issues of levels of automation, physical environments, information background, and training requirements are being addressed by such man/machine analysis systems. This research investigates the close interrelation between models of human cognition and models that describe procedural performance. We describe a methodology for the decomposition of dynamic procedures that supports interaction with models of cognition on the basis of observed procedures; that serves to identify contradictions between observed procedures and current environment requirements, and that provides the structure to support methods for function allocation among crew and aiding systems.

Our approach is to develop an object-oriented, modular, executable software representation of the system, the aircraft, and the procedures necessary to accomplish flight tasks. We then encode this in a frame-based language, taxonomies of the conceptual, relational, and procedural constraints among the cockpit avionics and control systems and the aircraft. We have designed and implemented a ground procedures hierarchical representation sufficient to describe procedural flow in the cockpit. We then execute the procedural representation in simulation software and calculate the values of the flight instruments, aircraft state variables and crew resources using the constraints available from the relationship taxonomies. The system provides a flexible, extensible, and enforceable representation of the aircraft applicable to a large range of problem tasks and problem-solution task-analysis. The representation supports development methods of system interfaces, information, and functional allocation. We are interested in linking the procedural representation to models that function to establish several inferential inference methods including procedural backtracking with concurrent search, temporal reasoning, and counter checking for partial ordering of procedures. Vastly the representation is being linked to models of human decision making processes that include heuristic, propositional, and prescriptive judgement models that are sensitive to the procedural context in which the value judgments are being performed.


The use of cockpit avionics to guide flight control is not always an option (e.g., low-level, nocturnal flight). Under such circumstances the pilot must use out-the-window information for control and navigation. Thus it is important to determine the basis of visually guided flight for several reasons: 1) to guide the design and construction of the visual displays used in training simulators; 2) to model the variation in visibility brought about by weather, cockpit distortions, or distortions introduced by sensor systems; and 3) to aid in the development of displays that are appropriate to the cockpit window scene and are compatible with the pilot's visual extraction of information from the visual scene. The authors are actively pursuing these questions. We have ongoing studies using both low-cost, lower fidelity flight simulators, and state-of-the-art helicopter simulation research facilities. Research results will be presented on: 1) the important visual scene information used in attitude and position control; 2) the utility of monocular, stereo, and hyperspectral cues for the control of flight; 3) perceptual effects due to the differences between normal and night vision; and that made available by various night vision devices (e.g., light-intensifying goggles and infra-red sensor displays); and 4) the utility of advanced contact displays in which instrument information is made part of the visual scene, as on a "scene-linked" head-up display (e.g., displaying altitude information on a virtual billboard located on the ground).

USING AND DESIGNING PROCEDURES: LESSONS LEARNED FROM AVIATION. A. Decani

San Jose State University Foundation, San Jose, CA 95106.

E. L. Wiewer, University of Miami, Coral Gables, FL 33124

Procedures drive almost every task and sub-task on the flight deck of a commercial airliner. Failure to conform to Standard Operating Procedures (SOP) is frequently listed as the cause of violations, incidents, and accidents. Moreover, according to a study of 93 commercial aviation accidents, the leading crew-caused factor in aviation accidents was "pilot deviation from basic operational procedures" (Lautman and Gallimore, 1988). However, in most cases procedures and checklists are designed piecemeal, rather than based on a broad philosophical and on policies for operations. A framework of philosophy, policies, procedures and their relationship to the actual practices on the flight-deck is suggested. Initial results of an ongoing field-study to establish the usefulness of these concepts will be reported.


The panel will consist of five presentations on human factor issues in military aircraft accidents, focusing on immediate and future concerns. The U.S. Army will discuss the underlying causes of aircraft accidents during Desert Shield/Storm and compare to the non-combat environment. The U.S. Navy will review the trends and causes of Naval aviation accidents and the effect on current training. The U.S. Air Force will present the problem of human error data from aircraft accidents. The Royal Air Force will discuss their proposed system to collect and analyze human error data from aircraft accidents. The Royal Air Force will describe recent studies concerning emergency egress equipment.